

## **Prefabrication and HPC to Improve Constructibility and Minimize Traffic Disruptions**

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In 2001 the AASHTO Technology Implementation Group (TIG), formed to facilitate rapid acceptance and implementation of high-payoff and innovative technologies, selected prefabricated bridge elements and systems as one of its areas for implementation. Prefabrication improves constructibility and reduces construction time over traffic, thereby minimizing traffic disruptions and improving work-zone safety. Combining prefabrication and HPC improves quality and durability as a result of the controlled environment in which the elements and systems are constructed and the improved concrete matrix.

### **Texas and Prefabricated Bridge Elements and Systems**

Texas has long used prefabricated bridge members to improve constructibility and is increasingly appreciating the capacity of prefabrication to not only reduce inconvenience to the traveling public during bridge construction but also to improve long-term performance.

In the mid-1950s, Texas began using precast prestressed concrete beams with standard beam shapes, and today they are the “work horse” of Texas highway bridge construction. Beginning in 1963, Texas developed a composite concrete deck system consisting of precast concrete deck panels and a cast-in-place concrete topping. This partially prefabricated deck system caught on slowly, and now panels are typically the contractor-preferred system for constructing bridge decks in Texas. These prefabricated panels function as stay-in-place forms and also provide a significant structural member for strength.

The following two examples demonstrate the growing popularity of prefabrication in Texas:

- The Louetta Road Overpass project in Houston was the first bridge in the country to use HPC for both the superstructure and the substructure. This project combined prefabricated HPC elements – the high-strength beams and the partial-depth deck panels – with an HPC system – the high-strength precast hollow core post-tensioned piers.
- During plans in 1996 to replace 113 spans of the Pierce Elevated section of IH45 in Houston’s central business district, designers realized that a conventional bridge substructure having cast-in-place bent caps would require a year and a half to complete construction, with user delay costs estimated at \$100,000 a day. TxDOT instead opted to use precast bent caps and completed work in just 95 days.

Texas now routinely considers prefabrication to address traffic disruption and constructibility issues in specific projects. An example is the Lake Ray Hubbard bridge project near Dallas. The contractor for this 102-span bridge project entirely over water proposed precast bent caps to speed construction and simplify concrete delivery for the substructure construction. Let in 2000, this project is using HPC with 35% of the cement replaced with ground-granulated blast-furnace slag (GGBFS) to reduce permeability and, thereby, improve durability of the structure. GGBFS concrete has slower strength gain, and using precast caps allowed this slower strength gain to occur off-site while foundations and columns were constructed on-site.

### **Benefits from Using Prefabricated Elements and Systems Combined with HPC**

The prefabrication in these projects provides more control over the construction environment, minimizes work-zone risks, and reduces inconvenience to the public. It also alleviates time pressures during construction, removing concrete strength gain from a project’s critical path.

Texas promotes the use of HPC in its bridges. The longer curing and strength-gain times typically required for HPC can be better managed using prefabricated elements and systems. In addition, curing requirements for HPC are more efficiently met for prefabricated elements and systems, e.g., deck surfaces can more easily be finished properly and covered promptly. While high-strength HPC, with compressive strengths greater than 9000 psi, is used when needed for beam design, Texas is concentrating on the general use of conventional-strength HPC with its improved durability performance.

Bent caps for the Lake Ray Hubbard project are precast at the jobsite.



Combining precasting and HPC in the Lake Ray Hubbard bent caps improves constructibility and durability performance.

